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| 09/945,535 | 08/30/2001 | Kie Y. Ahn | 1303.026US1 | 2681 |

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| EXAMINER | |
|---|---|
| BLUM, DAVID S | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2813 | |

DATE MAILED: 11/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

H·A

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/945,535 | AHN ET AL. | |
| | Examiner | Art Unit | |
| | David S. Blum | 2813 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *26 October 2005* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1,2,5-10,13-15,17-23,26-31,34-37,51,52,54-56 and 62* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,5-10,13-15,17-23,26-31,34-37,51,52,54-56 and 62* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *6/13&10/26/05*
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

This action is in response to the amendment filed 10/26/05.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-2, 4-6, 14-15, 17-20, 51-52, and 55-56 and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma (US6207589) in view of Park (US 5795808) and Yano (US005810923A).

Ma teaches all of the positive steps of claims 1-2, 4-6, 14-15, 17-20, 51-52, and 55-56 and 62 except for using electron beam evaporation to deposit the single element metal layer and that the metal oxide layer has a smooth surface roughness variation of 0.6nm and except for the deposition temperature and the use of atomic oxygen.

Regarding the process steps recited in the "product by process claims" of claims 51-52 and 54, the process steps are given no weight in product or device claims and the device is taught as recited below. In re Thorpe, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir 1985).

Ma teaches sputtering (column 2 line 20), chemical vapor deposition as an alternative (column 2 line 38) or as another alternative, **evaporation deposition** (column 2 lines 54-55), giving the three methods an art recognized equivalence. Ma is silent to the evaporation deposition method used; the broad group includes electron beam evaporation. The evaporation deposition method may include a single metal (column 2 lines 65-67, zirconium, a group IVB element) and oxidizing the metal (column 3 lines 1-4) to form a metal alloy. The metal is amorphous (column 3 lines 53-55 and 60-62), and is directly on (contacting) the body region (figure 12).

Park teaches depositing a metal layer (zirconium as in the instant claims and Ma) by either sputtering or electron beam deposition (column 4 lines 22-27), giving the two an art recognized equivalence.

Ma and Park are silent as to the surface roughness or smoothness. Yano teaches evaporation depositing a single metal layer (prefers Zrsub(1-x)RsubxOsub2 but teaches x may equal 0, thus a single metal, abstract), and oxidizing the metal (column 9 lines 1-6,metal may be deposited first and then oxidized), and teaches the surface roughness is up to 0.6nm across the surface. Thus the smoothness is within the instant claims. Yano teaches a preference toward a crystalline metal rather than amorphous, but also teaches that it s known to make the layer amorphous. Also, the instant specification teaches the metal layer may be either amorphous or crystalline, with no criticality taught between the two structures.

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions or of any unexpected results arising there from. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Thus, the method of Yano reads on that of Ma and Park (as well as the crystalline embodiment of the instant specification. Although silent as to the surface smoothness/roughness, without evidence to the contrary, one of ordinary skill in the art upon reading Yano, would expect the process of Ma and Park to yield a surface roughness up to 0.6nm across the surface.

Regarding claims 14 and 51, the gate is coupled to the metal oxide layer (Ma figure 13).

Regarding claims 2, 16, and 52 both Ma (column 2 line 67) and Park (column 4 line 25) teach depositing a zirconium layer.

Regarding claims 4 and 17, the metal of Park is 99.0% pure or higher (column 4 lines 24-27).

Regarding claims 5 and 18, Park is silent as to the deposition temperature when using electron beam evaporation. Yano teaches zirconium is deposited at 300-700 degrees C, within the range of the instant claim.

Regarding claims 6 and 19, Ma teaches oxidizing at 400 degrees (column 3 line 2).

Regarding claims 7 and 20, Yano oxidized with atomic oxygen (column 21, lines 35-36, oxygen, ozone, atomic oxygen, and NO2, teaching an art recognized equivalence), suggesting Ma also use atomic oxygen.

Regarding claim 56, the limitation of forming the layer with a conduction band offset in a range of 5.16-7.8 eV, as the process steps are identical and there is no teaching as to modifying the process to achieve the specified range, it is considered to be a range of common use, and one skilled in the requisite art would know how to optimize the process to achieve this range.

These ranges are considered to involve routine optimization while it has been held to be within the level of ordinary skill in the art. As noted in In re Aller (105 USPQ233), the selection of reaction parameters such as temperature and concentration would have been obvious:

> "Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art. Such ranges are termed "critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."
>
> In re Aller 105 USPQ233, 255 (CCPA 1955). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ

314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).

One skilled in the requisite art at the time of the invention would have used any ranges or exact figures suitable to the method in the process of forming a gate oxide regarding band offsets using prior knowledge, experimentation, and observation with the apparatus used in order to optimize the process and produce the gate structure desired to the parameters desired.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Ma by using electron beam evaporation as taught by Park to be an art recognized equivalent to sputtering.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Ma and Park to use a known deposition range for electron beam evaporation of zirconium as taught by Yano and to use atomic oxygen as taught by Yano to be an art recognized equivalence to oxygen. One would not perform undue and expensive laboratory efforts to obtain known values.

3. Claims 8, 21, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma (US6207589) in view of Park (US 5795808) and Yano (US005810923A) and in further view of Moise (US 006211035).

Ma, Park and Yano teach all of the positive steps of claims 8, 21, and 54 as recited above in regard to claims 1, 14, and 51 except for oxidizing in a krypton/oxygen mixed plasma.

Ma teaches annealing in an oxygen plasma including inert gases such as argon, and nitrogen (column 6 lines 64-65). Moise teaches oxidizing a metal layer with inert gasses such as argon or krypton (column 12 lines 23-24) giving the two an art recognized equivalence.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Ma, Park, and Yano by oxidizing a metal layer with inert gasses such as argon or krypton (column 12 lines 23-24) as taught by Moise to have an art recognized equivalence.

4. Claims 9-10 and 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma (US6207589) in view of Park (US 5795808) and Yano (US005810923A) and in further view of Moise (US006211035).

Ma teaches all of the positive steps of claims 9-10 and 12-13 except for using electron beam evaporation to deposit the single element metal layer and oxidizing in a krypton/oxygen mixed plasma, and except for the deposition temperature.

Ma teaches sputtering (column 2 line 20), chemical vapor deposition as an alternative (column 2 line 38) or as another alternative, evaporation deposition (column 2 lines 54-55), giving the three methods an art recognized equivalence. Ma is silent to the evaporation deposition method used; the broad group includes electron beam evaporation. The evaporation deposition method may include a single metal (column 2 lines 65-67) and oxidizing the metal (column 3 lines 1-4) to form a metal alloy. The metal is amorphous (column 3 lines 53-55 and 60-62), and is directly on (contacting) the body region (figure 12).

Park teaches depositing a metal layer (zirconium as in the instant claims and Ma) by either sputtering or electron beam deposition (column 4 lines 22-27), giving the two an art recognized equivalence.

Ma teaches annealing in an oxygen plasma including inert gases such as argon, and nitrogen (column 6 lines 64-65). Moise teaches oxidizing a metal layer with inert gasses such as argon or krypton (column 12 lines 23-24) giving the two an art recognized equivalence.

Regarding claim 10, both Ma (column 2 line 67) and Park) column 4 line 25) teach depositing a zirconium layer.

Regarding claim 12, the metal of Park is 99.0% pure or higher (column 4 lines 24-27).

It would be obvious to one skilled in the requisite art at the time of the invention to modify Ma by using electron beam evaporation as taught by Park to be an art

recognized equivalent to sputtering, and to oxidize a metal layer with inert gasses such as argon or krypton (column 12 lines 23-24) as taught by Moise to have an art recognized equivalence.

Regarding claim 13, Park is silent as to the deposition temperature when using electron beam evaporation. Yano teaches zirconium is deposited at 300-700 degrees C, within the range of the instant claim.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Ma and Park to use a known deposition range for electron beam evaporation of zirconium as taught by Yano. One would not perform undue and expensive laboratory efforts to obtain known values.

5. Claims 22-23, 25-28, 30-31, and 33-36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma (US6207589) in view of Park (US 5795808) and Yano (US005810923A), and in further view of Maiti (US6020024) and the admitted prior art (pages 1-4).

Ma teaches all of the positive steps of claims 22-23, 25-28, 30-31, and 33-36 except for using electron beam evaporation to deposit the single element metal layer and for wordlines, sourcelines and bitlines and except for the deposition temperature and the use of atomic oxygen.

Ma teaches sputtering (column 2 line 20), chemical vapor deposition as an alternative (column 2 line 38) or as another alternative, evaporation deposition (column 2 lines 54-55), giving the three methods an art recognized equivalence. Ma is silent to the evaporation deposition method used; the broad group includes electron beam evaporation. The evaporation deposition method may include a single metal (column 2 lines 65-67) and oxidizing the metal (column 3 lines 1-4) to form a metal alloy. The metal is amorphous (column 3 lines 53-55 and 60-62), and is directly on (contacting) the body region (figure 12).

Park teaches depositing a metal layer (zirconium as in the instant claims and Ma) by either sputtering or electron beam deposition (column 4 lines 22-27), giving the two an art recognized equivalence.

Maiti teaches that devices (transistors) formed of a metal oxide with a high k metal oxide gate are commonly used for ICs. The admitted prior art (pages 1-4) teaches that these devices are commonly used in ICs, particularly for processor chips, mobile telephones, and memory devices. These devices commonly use wordlines, sourcelines, bit lines, and system busses. The gate is coupled to the metal oxide layer (Ma figure 13).

Regarding claims 23 and 31 both Ma (column 2 line 67) and Park) column 4 line 25) teach depositing a zirconium layer.

Regarding claims 25 and 33, the metal of Park is 99.0% pure or higher (column 4 lines 24-27).

Regarding claims 27 and 35, Ma teaches oxidizing at 400 degrees (column 3 line 2).

It would be obvious to one skilled in the requisite art at the time of the invention to modify Ma by using electron beam evaporation as taught by Park to be an art recognized equivalent to sputtering and to form wordlines, sourcelines, bit lines, and system busses as these are parts of the devices taught by the admitted prior art.

Regarding claims 26 and 34, Park is silent as to the deposition temperature when using electron beam evaporation. Yano teaches zirconium is deposited at 300-700 degrees C, within the range of the instant claim.

Regarding claims 28 and 36, Yano oxidized with atomic oxygen (column 21, lines 35-36, oxygen, ozone, atomic oxygen, and NO2, teaching an art recognized equivalence), suggesting Ma also use atomic oxygen.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Ma and Park by using a known deposition range for electron beam evaporation of zirconium as taught by Yano and to use atomic oxygen as taught by Yano to be an art recognized equivalence to oxygen. One would not perform undue and expensive laboratory efforts to obtain known values.

6. Claims 29 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma (US6207589) in view of Park (US 5795808) and Yano (US005810923A), and in further view of Maiti (US6020024) and the admitted prior art (pages 1-4) and in further view of Moise (US 006211035).

Ma, Park, and Yano teach all of the positive steps of claims 29and 37 as recited above in regard to claims 22 and 30, except for oxidizing in a krypton/oxygen mixed plasma.

Ma teaches annealing in an oxygen plasma including inert gases such as argon, and nitrogen (column 6 lines 64-65). Moise teaches oxidizing a metal layer with inert gasses such as argon or krypton (column 12 lines 23-24) giving the two an art recognized equivalence.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Ma and Park by oxidizing a metal layer with inert gasses such as argon or krypton (column 12 lines 23-24) as taught by Moise to have an art recognized equivalence.

***Response to Arguments***

7. Applicant's arguments with respect to claim1-2, 5-10, 13-15, 18-23, 26-31, 34-37, 51-52, and 54-56 have been considered but are moot in view of the new ground(s) of rejection.

The examiner would like to address one argument, that where the applicant argues Ma teaches a metal layer with a percentage of aluminum or other trivalent metal layer of 25% in content. Ma teaches a preference toward 25%, but also teaches the content level may be 0%. This is similar to Yano teaching Zrsub(1-x)RsubxOsub2 and teaching x may equal 0, even though preferring X being greater than 0. despite this, the teaching is clear, a 0% content is also taught.

***Conclusion***

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Blum whose telephone number is (571)-272-1687) and e-mail address is David.blum@USPTO.gov .

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached at (571)-272-1702. Our facsimile number all patent correspondence to be entered into an application is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

David S. Blum

November 2, 2005